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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/086,614	03/01/2002	Paul B. Mirkarimi	CIL-10972	1932

7590 02/16/2005

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EXAMINER	
MARKHAM, WESLEY D	
ART UNIT	**PAPER NUMBER**
1762	

DATE MAILED: 02/16/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 10/03)

Office Action Summary	Application No. 10/086,614	Applicant(s) MIRKARIMI ET AL.	
	Examiner Wesley D Markham	Art Unit 1762	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *06 December 2004*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-20* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-20* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *01 March 2002* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Response to Amendment

1. Acknowledgement is made of the amendment filed by the applicant on 12/6/2004, in which Claims 17 – 20 were amended. **Claims 1 – 20** are currently pending in U.S. Application Serial No. 10/086,614, and an Office Action on the merits follows.
2. The indicated allowability of Claims 1 – 16 is withdrawn in view of several newly discovered reference(s). Rejections based on the newly cited reference(s) follow.

Drawings

3. The formal drawings (7 sheets) filed by the applicant on 3/1/2002 are approved by the examiner.

Specification

4. The abstract of the disclosure is objected to because the phrase, "A secondary ion source is used to etch the Si layers in between etch steps…" appears to contain a typographical error that renders the aforementioned phrase confusing. The applicant is suggested to amend the aforementioned phrase to read, "A secondary ion source is used to etch the Si layers in between <u>each</u> step…" (see page 4, lines 2 – 4, of the specification). Correction is required. See MPEP § 608.01(b).
5. The specification is objected to as failing to provide proper antecedent basis for the claimed subject matter. See 37 CFR 1.75(d)(1) and MPEP § 608.01(o). Correction of the following is required: The specification does not provide antecedent basis for

the following claim limitations: (1) a bi-layer comprising a layer of silicon and a layer of beryllium (Claims 9 and 20), and (2) removal of a fraction of the amorphous layer between the values of 0.05 and 1 (Claim 15).

Claim Rejections - 35 USC § 102

6. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claim Rejections - 35 USC § 103

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

8. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the

obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

9. Claims 1, 4, and 5 are rejected under 35 U.S.C. 102(e) as being anticipated by Mearini et al. (USPN 6,767,475).

10. Regarding independent **Claim 1**, Mearini et al. teaches a method for the mitigation of topological defects of an optical material, wherein the optical material comprises at least one layer of amorphous material (e.g., amorphous carbon), the method comprising planarizing with an ion beam only the at least one layer of amorphous material (Abstract, Figures 2 – 3, Col.2, lines 46 – 67, Col.3, Col.4, lines 1 – 16 and 53 – 67, Col.5, lines 1 – 56). Regarding **Claim 4**, Mearini et al. also teaches depositing the layer(s) of amorphous material onto a substrate prior to planarizing (Figure 2, Col.4, lines 61 – 67, Col.5, lines 1 – 7 and 26 – 33). Regarding **Claim 5**, Mearini et al. also teaches a plurality of layers of amorphous material, the method comprising planarizing each layer of the plurality of layers of amorphous material (Col.2, lines 56 – 67, Col.3, lines 1 – 24).

11. Claims 6 and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mearini et al.

12. Regarding **Claim 6**, Mearini et al. also teaches that the step of planarizing is carried out with an oxygen ion beam (Col.2, lines 62 – 67), which the examiner has reasonably interpreted to be a "secondary ion beam", and that the amorphous carbon material is deposited by any process, such as ion beam assisted deposition (IBAD), ion beam sputter deposition (IBSD), IBD, PECVD, etc., so long as sound engineering judgment is used (Col.4, lines 65 – 67, Col.5, lines 26 – 33). Therefore, it would have been obvious to one of ordinary skill in the art to utilize any of the ion beam deposition processes taught by Mearini et al. to deposit the amorphous carbon material, and in doing so, to utilize the requisite ion beam (i.e., a "primary ion beam") in the deposition process because Mearini et al. explicitly teaches that ion beam deposition can be utilized, and an ion beam of some kind (i.e., a "primary ion beam") must be utilized to carry-out any ion beam-based deposition process. Regarding **Claim 15**, Mearini et al. does not explicitly teach planarizing the amorphous material by removing a fraction of the layer between the values of 0.05 and 1 (i.e., between 5% and 100% of the layer). However, Mearini et al. does teach that the layer(s) of amorphous carbon can be deposited to a variety of thicknesses (e.g., 1 – 10 nm) and that the ion beam is directed onto the carbon coated surface so that only the carbon that protrudes above the average surface height is removed. The process is maintained until the layer of carbon is reduced to the level of the highest peaks in the surface of the film in order to fill in the valleys and level the initially rough surface (Col.5, lines 26 – 44). In other words, Mearini et al. teaches that the amount of the carbon layer that is removed is a result / effective variable that depends on the initial

thickness of the carbon layer and the overall roughness (e.g., peak-to-valley depth) of the initially rough surface. Therefore, it would have been obvious to one of ordinary skill in the art to optimize the amount (fraction) of carbon layer removal in the process of Mearini et al. as a result / effective variable through routine experimentation, depending on the initial thickness of the deposited carbon and the required thickness of the carbon layer after the ion beam planarization.

13. Claims 7, 16, and 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mearini et al. in view of Lu et al. (USPN 4,904,083) and Fairbairn et al. (USPN 6,573,030).

14. Mearini et al. teaches all the limitations of **Claims 7, 16, and 18** as set forth above in paragraph 10, except for a method / article wherein the at least one layer of amorphous material (carbon) has an index of refraction that is less than a material that forms another layer of the bi-layer. Please note that Mearini et al. does teach that the optical material comprises a bi-layer of optical material (e.g., a layer of amorphous carbon and a layer of a high-refractive index oxide such as titanium dioxide) on a substrate (Col.3, lines 1 – 11), as required by the claims. Mearini et al. does not explicitly teach that the layer of amorphous carbon has a lower index of refraction than the layer of titanium dioxide. Specifically, Mearini et al. is silent regarding the refractive index of the amorphous carbon layer(s), but teaches that the titanium dioxide layer(s) have a high refractive index (Col.5, lines 17 – 18). Lu et al. teaches that titanium dioxide layers are typically characterized by a high refractive

index of 2.32 (Col.2, lines 14 – 15, Col.4, lines 3 – 5), and Fairbairn et al. teaches that amorphous carbon films typically have a refractive index in the range of 1.5 to 1.9 (Col.3, lines 3 – 8 and 25 – 35). It would have been obvious to one of ordinary skill in the art to deposit the titanium dioxide layers of Mearini et al. to have a high refractive index of 2.32, as taught by Lu et al., because Mearini et al. teaches that such layers should have a high refractive index, and Lu et al. teaches that titanium dioxide can have a high refractive index of 2.32. Additionally, it would have been obvious to one of ordinary skill in the art to deposit the amorphous carbon film(s) of Mearini et al. to have any refractive index value known in the art for amorphous carbon (e.g., 1.5 – 1.9) because the refractive index of the amorphous carbon does not appear to be limited in the process of Mearini et al. In doing so, the refractive index of the amorphous carbon layer(s) of Mearini et al. is lower than the refractive index of the titanium dioxide layer(s). Further and regarding Claims 16 and 18, Mearini et al. does not explicitly teach that the optical article is an "EUV reticle". However, the structure of the article reasonably suggested by the combination of Mearini et al., Lu et al., and Fairbairn et al. (see the discussion above) is identical to the structure of the claimed "EUV reticle". Therefore, unless essential limitations are missing from the applicant's claims, the multilayer optical article taught by Mearini et al. is an "EUV reticle", as claimed by the applicant.

15. Claim 14 is rejected under 35 U.S.C. 103(a) as being unpatentable over Mearini et al. in view of Schmidt et al. (USPN 5,266,409).

16. Mearini et al. teaches all the limitations of **Claim 14** as set forth above in paragraphs 10 and 12, except for a method wherein at least one of the primary ion beam and the secondary ion beam comprises a source gas selected from the group consisting of Ar, Kr, Ne, and Xe. Specifically, Mearini et al. is silent regarding the source gas used in the ion beam for the amorphous carbon deposition process. However, Schmidt et al. teaches that Ar can be used as an ion beam source gas in an amorphous carbon ion beam deposition process (Col.5, lines 3 – 5, Col.15, lines 10 – 21). Therefore, it would have been obvious to one of ordinary skill in the art to use an inert gas such as Ar in the ion beam deposition process of Mearini et al. with the reasonable expectation of successfully and advantageously achieving the goal Mearini et al. (i.e., ion beam depositing an amorphous carbon film) by using an ion beam (i.e., an Ar ion beam) that is specifically taught by the art to carry-out such a process.

17. Claims 1 – 8, 10, 14, and 16 – 19 are rejected under 35 U.S.C. 102(e) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Murakami et al. (USPN 6,295,164).

18. Regarding independent **Claim 1**, Murakami et al. teaches a method for the mitigation of topological defects of an optical material, wherein the optical material comprises at least one layer of silicon deposited by ion beam sputter deposition (i.e., an "amorphous material"), the method comprising planarizing with an ion beam the at least one layer of silicon (i.e., the layer(s) of amorphous material) (Abstract, Figures 2A – 2C, 8, 9A, 9B, 10D, and 10E; Col.1, lines 10 – 17, Col.2, lines 29 – 51,

Col.3, lines 4 – 5 and 61 – 67, Col.4, lines 1 – 9 and 40 – 48, Col.5, lines 50 – 55, Col.6, lines 40 – 61, Col.7, lines 57 – 67, Col.8, Col.9, lines 1 – 19, Col.11, lines 35 – 67, Cols.12 – 14, Col.15, lines 56 – 67, and Col.16, lines 1 – 36). Regarding independent **Claim 16**, Murakami et al. teaches an EUV reticle, comprising a bi-layer of optical material on a substrate, wherein at least one layer of amorphous material (i.e., ion beam sputter deposited Si) forms one layer of the bi-layer and has an index of refraction that is less than a material that forms another layer of the bi-layer (i.e., Mo), wherein the layer(s) of amorphous material have been planarized with an ion beam (Abstract, Figures 2A – 2C, 8, 9A, 9B, 10D, and 10E; Col.1, lines 10 – 17, Col.2, lines 29 – 51, Col.3, lines 4 – 5 and 61 – 67, Col.4, lines 1 – 9 and 40 – 48, Col.5, lines 50 – 55, Col.6, lines 40 – 61, Col.7, lines 57 – 67, Col.8, Col.9, lines 1 – 19, Col.11, lines 35 – 67, Cols.12 – 14, Col.15, lines 56 – 67, and Col.16, lines 1 – 36). Further, Murakami et al. teaches that either the first layer (i.e., the Si layer(s)), the second layer (i.e., the Mo layer(s)), or both are planarized with the ion beam (Col.12, lines 31 – 55), and that the ion beam planarization may be carried out for <u>just one type of layer</u> (i.e., the Si layer or the Mo layer) of the alternating multilayer film (Col.16, lines 29 – 36). As such, Murakami et al. teaches planarizing only the layer(s) of amorphous material (i.e., the layers of Si) with the ion beam, as recited in the claims. Alternatively, it would have been obvious to one of ordinary skill in the art to ion beam planarize only the Si (amorphous) layers of Murakami et al. because Murakami et al. explicitly teaches that planarizing only one type of layer (e.g., the Si layer(s) or the Mo layer(s)) is sufficient to reap the benefits of the

process (e.g., producing a multilayered mirror having reduced stress and higher efficiency / performance). Regarding **Claims 2 – 4 and 17**, Murakami et al. also teaches that the amorphous material layer(s) is/are silicon layers deposited on a substrate prior to ion beam planarizing (Col.7, lines 57 – 67, Col.8, lines 1 – 14). Regarding **Claims 5 and 18**, Murakami et al. also teaches a plurality of layers of Si (amorphous material) and planarizing each layer of the plurality of layers (see the discussion of Claims 1 and 16 above). Regarding **Claims 6 and 14**, Murakami et al. also teaches depositing the amorphous material (Si) with a primary ion beam, and planarizing with a secondary ion beam, wherein the ion beam(s) comprise a source gas selected from the group of Ar, Kr, Ne, and Xe (Figures 8, 9A, and 9B; Col.8, lines 55 – 67, Col.9, lines 1 – 13, Col.12, lines 37 – 67, Col.13, lines 1 – 58, Col.15, lines 56 – 67, Col.16, lines 1 – 36). Regarding **Claims 7, 8, and 19**, Murakami et al. also teaches that the optical material comprises a bi-layer of optical material on a substrate, wherein Si (the amorphous material having a low refractive index) forms one layer of the bi-layer and Mo (the material having a high refractive index) forms another layer of the bi-layer (Figure 2; Col.4, lines 1 – 9 and 41 – 47, Col.7, lines 57 – 65). Regarding **Claim 10**, Murakami et al. also teaches that the silicon layer is an element of an EUV reticle (Col.2, lines 38 – 41 and 66).

19. Claims 9, 13, and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Murakami et al. in view of Hawryluk (USPN 5,745,286).

20. Murakami et al. teaches all the limitations of **Claims 9, 13, and 20** as set forth above in paragraph 18, except for a method / reticle wherein Si forms one layer of the bi-layer and Be forms another layer of the bi-layer. Specifically, Murakami et al. focuses on a Mo/Si multilayer mirror, but generally teaches that alternating layers of heavy-atom materials and light-atom materials having different refractive indexes can be utilized in the invention (Col.4, lines 1 – 9 and 40 – 47, Col.7, lines 57 – 65, and Cols.12 – 13). Hawryluk teaches that multilayers of materials such as Si, Mo, and Be, among others, are typically utilized in multilayer mirrors suitable for EUV reflection (Abstract, Col.1, lines 11 – 30, Col.3, lines 25 – 50, and Claim 7). Therefore, it would have been obvious to one of ordinary skill in the art to produce the multilayer mirror of Murakami et al. to have alternating layers of Si and Be instead of Si and Mo with the reasonable expectation of (1) success, as Hawryluk teaches that Be can be utilized in multilayer mirrors for EUV reflection, and the particular materials of the multilayer mirror of Murakami et al. do not appear to be particularly limited, and (2) reaping the benefits of the process of Murakami et al. (i.e., producing a mirror having a high reflectivity and low stress due to the ion beam polishing), regardless of whether Mo or Be is utilized along with Si in the multilayer mirror structure. Please note that Murakami et al. does teach ion beam planarizing with an ion beam energy in the range of 50 – 2000 eV, as required by Claim 13 (Col.13, lines 57 – 58).

21. Claim 11 is rejected under 35 U.S.C. 103(a) as being unpatentable over Murakami et al. in view of Mirkarimi et al. ("Investigating the growth of localized defects in thin films using gold nanoparticles", October 2000).

22. Murakami et al. teaches all the limitations of **Claim 11** as set forth above in paragraph 18, except for a method wherein the ion beam sputter deposition takes place at near-normal incidence, and the subsequent ion beam etching takes place at near-normal incidence. However, Murakami et al. teaches that the angle of incidence of the ion beam etching is an important parameter that is optimized for each layer of the multilayer mirror (Col.13, lines 53 – 57) and influences factors such as the film stress (Table 2). In other words, Murakami et al. teaches that the angle of incidence of the ion beam etching is a result / effective variable that is optimized based on the specific material of the layer and the film stress desired by the purveyor in the art. Therefore, it would have been obvious to one of ordinary skill in the art to optimize the angle of incidence of the ion beam etching as a result / effective variable through routine experimentation. Such optimization would be based on (1) the material of the etched film, and (2) the type (or change) of stress in the layer desired by one in the art. Further, Murakami et al. generally teaches that the substrate is positioned to face the target during the ion beam sputter deposition process (Figure 9A; Col.16, lines 5 – 15). Mirkarimi et al. teaches that, by carrying-out an ion beam sputter deposition process (e.g., of alternating layers of Mo and Si) at near-normal incidence, defect smoothing is greatly enhanced (see the entire document). Therefore, it would have been obvious to one of ordinary skill in the art

to perform the ion beam sputter deposition steps of Murakami et al. at near-normal incidence (as taught by Mirkarimi et al.) with the reasonable expectation of successfully and advantageously reaping the benefits of doing so, such as enhancing defect smoothing in the multilayer mirror, which is explicitly desired by Murakami et al.

23. Claim 12 is rejected under 35 U.S.C. 103(a) as being unpatentable over Murakami et al. in view of Knapp et al. (USPN 5,508,368).

24. Murakami et al. teaches all the limitations of **Claim 12** as set forth above in paragraph 18, except for a method wherein the ion beam sputter deposition of Si is performed with an ion beam energy of from about 400 – 2000 eV. Specifically, Murakami et al. is silent regarding the ion beam energy in the Si sputter deposition process. Knapp et al. teaches that an ion beam energy of 1000 eV (a value within the claimed range) is sufficient to perform ion beam sputter deposition of Si (Abstract, Col.16, lines 54 – 60). Therefore, it would have been obvious to one of ordinary skill in the art to utilize an ion beam energy of 1000 eV during the Si layer ion beam sputter deposition process of Murakami et al. because Knapp et al. teaches that such an ion beam energy is operable to achieve the goal of Murakami et al. (i.e., to deposit a Si layer by ion beam sputter deposition).

25. Claim 15 is rejected under 35 U.S.C. 103(a) as being unpatentable over Murakami et al.

26. Murakami et al. teaches all the limitations of **Claim 15** as set forth above in paragraph 18, except for a method wherein the step of planarizing removes between 5% and 100% of the amorphous (Si) layer. However, the goal of Murakami et al. is to ion beam polish the layer(s) in order to minimize the surface roughness thereof (Col.14, lines 25 – 36, Col.16, lines 19 – 23). It would have been obvious to one of ordinary skill in the art to remove as much of the layer as necessary, including an amount of the layer within the broad range of 5% and 100% of the layer, to achieve the goal of Murakami et al. (i.e., to smooth the layer and minimize the roughness of the layer). The percentage of the layer removed would, of course, depend on how rough the layer is to begin with.

27. Claims 1 – 8, 10, 14, and 16 – 19 are rejected under 35 U.S.C. 102(e) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Yakshin et al. (WO 03/036654 A1).

28. Regarding independent **Claim 1**, Yakshin et al. teaches a method for the mitigation of topological defects of an optical material, wherein the optical material comprises at least one layer of silicon deposited by ion beam sputter deposition (i.e., an "amorphous material"), the method comprising planarizing with an ion beam the at least one layer of silicon (i.e., the layer(s) of amorphous material) (Abstract, pages 1, 2, and 4 – 10). Regarding independent **Claim 16**, Yakshin et al. teaches an EUV reticle, comprising a bi-layer of optical material on a substrate, wherein at least one layer of amorphous material (i.e., ion beam sputter deposited Si) forms one layer of

the bi-layer and has an index of refraction that is less than a material that forms another layer of the bi-layer (i.e., Mo), wherein the layer(s) of amorphous material have been planarized with an ion beam (Abstract, pages 1, 2, and 4 – 10). Further, Yakshin et al. teaches that only the Si layer (the amorphous layer) is planarized with an ion beam after deposition (page 10, paragraph 3). As such, Yakshin et al. teaches planarizing only the layer(s) of amorphous material (i.e., the layers of Si) with the ion beam, as recited in the claims. Alternatively, it would have been obvious to one of ordinary skill in the art to ion beam planarize only the Si (amorphous) layers of Yakshin et al. because Yakshin et al. explicitly teaches that "at least one layer is irradiated with ions after being deposited" (page 1, paragraph 1), thereby reasonably suggesting to one of ordinary skill in the art that any or all layers of the multilayer mirror (e.g., the Si layers, the Mo layers, or both) can be ion beam planarized after deposition in order to achieve the goal of Yakshin et al. (e.g., to obtain the highest possible reflectivity of the mirror). Regarding **Claims 2 – 4 and 17**, Yakshin et al. also teaches that the amorphous material layer(s) is/are silicon layers deposited on a substrate prior to ion beam planarizing (pages 4, 6, 8, and 9). Regarding **Claims 5 and 18**, Yakshin et al. also teaches a plurality of layers of Si (amorphous material) and planarizing each layer of the plurality of layers (see the discussion of Claims 1 and 16 above). Regarding **Claims 6 and 14**, Yakshin et al. also teaches depositing the amorphous material (Si) with a primary ion beam, and planarizing with a secondary ion beam, wherein the ion beam(s) comprise a source gas selected from the group of Ar, Kr, Ne, and Xe (pages 1 and 4 – 10). Regarding

Claims 7, 8, and 19, Yakshin et al. also teaches that the optical material comprises a bi-layer of optical material on a substrate, wherein Si (the amorphous material having a low refractive index) forms one layer of the bi-layer and Mo (the material having a high refractive index) forms another layer of the bi-layer (page 1, paragraph 1, page 9, paragraph 3). Regarding **Claim 10**, Yakshin et al. also teaches that the silicon layer is an element of an EUV reticle (page 9, paragraph 3).

29. Claims 9, 13, and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yakshin et al. in view of Hawryluk (USPN 5,745,286).

30. Yakshin et al. teaches all the limitations of **Claims 9, 13, and 20** as set forth above in paragraph 28, except for a method / reticle wherein Si forms one layer of the bi-layer and Be forms another layer of the bi-layer. Specifically, Yakshin et al. focuses on a Mo/Si multilayer mirror, but generally teaches that alternating layers of a variety of elements / materials known in the art of EUV lithography mirrors can be utilized (paragraph bridging pages 4 and 5). Hawryluk teaches that multilayers of materials such as Si, Mo, and Be, among others, are typically utilized in multilayer mirrors suitable for EUV reflection (Abstract, Col.1, lines 11 – 30, Col.3, lines 25 – 50, and Claim 7). Therefore, it would have been obvious to one of ordinary skill in the art to produce the multilayer mirror of Yakshin et al. to have alternating layers of Si and Be instead of Si and Mo with the reasonable expectation of (1) success, as Hawryluk teaches that Be can be utilized in multilayer mirrors for EUV reflection, and the particular materials of the multilayer mirror of Yakshin et al. do not appear to be

particularly limited, and (2) reaping the benefits of the process of Yakshin et al. (i.e., producing a mirror having a high reflectivity), regardless of whether Mo or Be is utilized along with Si in the multilayer mirror structure. Please note that Yakshin et al. does teach ion beam planarizing with an ion beam energy in the range of 50 – 2000 eV, as required by Claim 13 (page 7, paragraph 1, page 9, paragraph 5).

31. Claim 11 is rejected under 35 U.S.C. 103(a) as being unpatentable over Yakshin et al. in view of Mirkarimi et al. ("Investigating the growth of localized defects in thin films using gold nanoparticles", October 2000).

32. Yakshin et al. teaches all the limitations of **Claim 11** as set forth above in paragraph 28, except for a method wherein the ion beam sputter deposition takes place at near-normal incidence, and the subsequent ion beam etching takes place at near-normal incidence. However, Yakshin et al. teaches that the entire surface to be coated should be uniformly irradiated with the ion beam, and the preferred embodiment is to utilize an ion beam having a diameter and shape to match that of the substrate (page 8, paragraph 3). Therefore, it would have been obvious to one of ordinary skill in the art to irradiate the ion beam of Yakshin et al. at near-normal incidence during the ion beam etching / planarization process so that the entire substrate is uniformly irradiated with the ion beam having a diameter and shape matching that of the substrate. Further, Mirkarimi et al. teaches that, by carrying-out an ion beam sputter deposition process (e.g., of alternating layers of Mo and Si) at near-normal incidence, defect smoothing is greatly enhanced (see the entire

document). Therefore, it would have been obvious to one of ordinary skill in the art to perform the ion beam sputter deposition steps of Yakshin et al. (page 8, paragraph 5) at near-normal incidence (as taught by Mirkarimi et al.) with the reasonable expectation of successfully and advantageously reaping the benefits of doing so, such as enhancing defect smoothing in the multilayer mirror, which is explicitly desired by Yakshin et al.

33. Claim 12 is rejected under 35 U.S.C. 103(a) as being unpatentable over Yakshin et al. in view of Knapp et al. (USPN 5,508,368).
34. Yakshin et al. teaches all the limitations of **Claim 12** as set forth above in paragraph 28, except for a method wherein the ion beam sputter deposition of Si is performed with an ion beam energy of from about 400 – 2000 eV. Specifically, Yakshin et al. is silent regarding the ion beam energy in the Si sputter deposition process. Knapp et al. teaches that an ion beam energy of 1000 eV (a value within the claimed range) is sufficient to perform ion beam sputter deposition of Si (Abstract, Col.16, lines 54 – 60). Therefore, it would have been obvious to one of ordinary skill in the art to utilize an ion beam energy of 1000 eV during the Si layer ion beam sputter deposition process of Yakshin et al. because Knapp et al. teaches that such an ion beam energy is operable to achieve the goal of Yakshin et al. (i.e., to deposit a Si layer by a method such as ion beam sputter deposition).

35. Claims 1 – 4 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sasai et al. (JP 10-300912 A) in view of Murakami et al.

36. Regarding **Claims 1 – 4**, Sasai et al. teaches a method for the production of an optical material (e.g., a diffraction grating), the method comprising depositing a layer of amorphous silicon onto a substrate, and then polishing the surface of the deposited amorphous silicon (Abstract, Figure 1). Only the layer of amorphous material is polished. Sasai et al. does not explicitly teach that the amorphous silicon polishing is performed with an ion beam. Specifically, the amorphous silicon layer is polished by a ball feeding method or a float polishing method (Abstract). Murakami et al. teaches that ion beam polishing can be successfully utilized to polish a Si layer and has the following advantages: (1) the ion beam controls the amount and type of stress in the layer, and (2) the ion beam reduces the roughness of the layer to an extremely low value (i.e., below 0.3 nm) (Col.8, lines 15 – 44, Col.14, lines 16 – 36). Therefore, it would have been obvious to one of ordinary skill in the art to polish / planarize the amorphous Si layer of Sasai et al. by ion beam polishing instead of with a ball feeding method or a float polishing method with the reasonable expectation of (1) success, as Murakami et al. teaches that ion beam polishing works for Si layers, and (2) obtaining the benefits of utilizing such a polishing method, such as controlling the amount and type of stress in the amorphous Si layer and polishing the surface to an extremely fine finish (low surface roughness).

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Shiraishi et al. (US 2002/0171922 A1) teaches machining (e.g., ion milling or polishing) the surface of an EUV multilayer mirror in order to achieve improved reflectivity. Mirkarimi et al. (USPN 6,319,635) teaches ion beam sputter depositing an EUV multilayer mirror at near-normal incidence. Spiller ("Smoothing of multilayer x-ray mirrors by ion polishing", June 1989) teaches ion beam polishing multilayer mirrors. Mirkarimi et al. ("An Ion-Assisted Mo-Si Deposition Process for Planarizing Reticle Substrates for Extreme Ultraviolet Lithography", December 2001) teaches ion beam depositing and ion beam etching Mo and Si layers of a multilayer EUV mirror at a near-normal incidence in order to planarize the layers of the mirror.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Wesley D Markham whose telephone number is (571) 272-1422. The examiner can normally be reached on Monday - Friday, 8:00 AM to 4:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Shrive Beck can be reached on (571) 272-1415. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

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